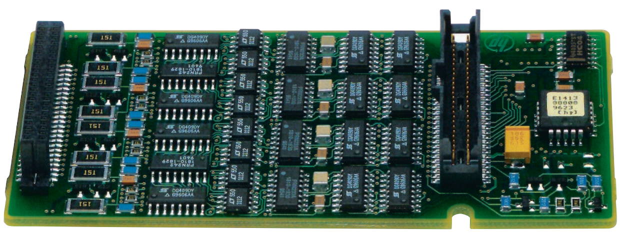
Agilent E1503A
8-Channel Programmable Filter/Gain SCP
Data Sheet

- Use with Agilent E1413C/E1415A/E1419A
- Programmable low-pass filter per channel
- Programmable input amplifier per channel
- ± 0.25/2/16 V maximum sensor voltage
- Maximum flexibility for low-level and high-level sensors



Agilent E1503A

Description

The Agilent E1503A 8-Channel Programmable Filter and Gain SCP provides eight programmable, 2-pole low-pass filters with cutoff frequency settings of 2, 10, and 100 Hz, as well as a 1.5 kHz “pass-through” mode (filter OFF). The eight programmable input amplifiers provide input voltage ranges of ± 0.25 V, ± 2 V, and ± 16 V. The E1503A SCP also provides input over-voltage protection and open transducer detection on each channel.

Measurement applications include low-level voltage, temperature, resistance, and strain measurements and general measurements of voltage output sensors.

Use the E1503A with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module (only in SCP positions 5 - 8)

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Voltage Measurements

The E1503A is ideal for measuring signals from sensors with full-scale voltage outputs from 3.9 mV to 16 V. The programmable, 2-pole, low-pass filters reduce sensor-based noise in the measurement.

Temperature Measurements

The E1503A can be used to make temperature measurements with thermocouples, thermistors, or RTDs.

Temperature measurements with thermistors or RTDs require the E1505A 8-Channel Current Source SCP. Engineering units conversion to degrees C are made on-card at full speed.

Resistance Measurements

Resistance is measured using the E1505A Current Source SCP with the E1503A SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown resistance. The current source is provided through the E1505A. The recommended application is as shown here using 4-wire Ω connections. Two-wire Ω measurement is possible but not recommended since two 150 Ω series resistors protecting the input FET multiplexer are included in the measurement.

Strain Measurements

The E1503A can be used to make strain measurements when combined with either the E1506A or E1507A Strain Completion SCPs. Refer to the E1506A/E1507A *Technical Specifications* for more information.

Product Specifications

These specifications for the E1503A reflect the combined performance of the scanning A/D and the E1503A SCP.

Measurement Ranges

DC Volts:	± 3.9 mV to ± 16 V Full Scale
Temperature:	
Thermocouples:	–200 to + 1700 °C
Thermistors: *	–80 to + 160 °C
RTD's: *	–200 to + 850 °C
Resistance: *	8 Ω to 131K Ω FS
Strain: **	25,000 με or limit of linear range of strain gage

*Requires Agilent E1505A.
**Requires Agilent E1506A/E1507A.

Input Characteristics

Maximum input voltage (normal mode plus common mode):	
Operating:	<± 16 V peak
Damage level:	>± 42 V peak
Maximum common mode voltage:	
Operating:	<± 16 V peak
Damage level:	>± 42 V peak
Common mode rejection:	
0 to 60 Hz:	
Gain x1:	>–100 dB
Gain x8:	>–116 dB
Gain x64:	>–132 dB
Input impedance:	Greater than 100 MΩ differential

Maximum Tare Cal Offset

Maximum tare cal offset depends on A/D range and SCP gain.

A/D Range ±V F. Scale	Offset V Gain x1	Offset V Gain x8	Offset V Gain x64
16	3.2213	.40104	.04970
4	.82101	.10101	.01220
1	.23061	.02721	.00297
0.25	.07581	.00786	.00055
0.0625	.03792	.00312	n/a

Measurement Accuracy DC Volts

If autoranging is ON, add ± .02% FS to accuracy specifications.

Gain x1

A/D Range ±V F. Scale	Linearity % of Reading	Offset Error				Noise 3σ	Noise* 3σ
		2 Hz	**10 Hz**	**100 Hz**	**Filt Off**		
.0625	0.01%	13 μV	9.5 μV	6.8 μV	6.3 μV	45 μV	26 μV
.25	0.01%	15 μV	12.5 μV	11.2 μV	10.8 μV	63 μV	31 μV
1	0.01%	33 μV	31.8 μV	31.3 μV	31.2 μV	112 μV	93 μV
4	0.01%	123 μV	122 μV	122 μV	122 μV	450 μV	366 μV
16	0.01%	488 μV	488 μV	488 μV	488 μV	1.8 mV	1.5 mV

*A/D filter ON (min sample period ≥145 μs: ≤100 Hz scan rate 64 ch).

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above.

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30 °C	0.16 μV/°C	0 μV	0 μV	0 μV	0 μV
	30-40 °C	0.18 μV/°C	13 μV	9 μV	1.1 μV	0.2 μV
	40-55 °C	0.39 μV/°C	31 μV	22 μV	6.4 μV	1.1 μV

Gain x8

A/D Range ±V F. Scale	Linearity % of Reading	Offset Error				Noise 3σ	Noise* 3σ
		2 Hz	**10 Hz**	**100 Hz**	**Filt Off**		
.0078	0.01%	4.6 μV	4.2 μV	3.8 μV	3.7 μV	5.8 μV	4.9 μV
.031	0.01%	4.8 μV	4.6 μV	4.4 μV	4.3 μV	6.9 μV**	5.9 μV**
.125	0.01%	6 μV	5.3 μV	5 μV	4.9 μV	14 μV	12 μV
.5	0.01%	16 μV	16 μV	16 μV	16 μV	56 μV	46 μV
2	0.01%	61 μV	61 μV	61 μV	61 μV	225 μV	188 μV

*A/D filter ON (min sample period ≥145 μs: ≤100 Hz scan rate 64 ch).
** 7.4 μV and 6.3 μV when temperature ≥40 °C

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above.

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30 °C	0.16 µV/°C	0 µV	0 µV	0 µV	0 µV
	30-40 °C	0.18 µV/°C	4.3 µV	2.7 µV	1 µV	0.2 µV
	40-55 °C	0.39 µV/°C	13 µV	10 µV	6.2 µV	0.8 µV

Gain x64

A/D Range ±V F. Scale	**Linearity % of Reading**	**Offset Error**				**Noise 3σ**	**Noise* 3σ**
		2 Hz	**10 Hz**	**100 Hz**	**Filt Off**		
.0039	0.01%	2.9 µV	2.3 µV	2.1 µV	2.1 µV	1.6 µV**	1.3 µV**
.0156	0.01%	3 µV	2.4 µV	2.2 µV	2.2 µV	2.2 µV***	1.9 µV***
.0625	0.01%	3.5 µV	3 µV	2.9 µV	2.9 µV	7 µV	5.7 µV
.25	0.01%	8.2 µV	8 µV	8 µV	8 µV	28 µV	23 µV

*A/D filter ON (min sample period ≥145 µs: ≤100 Hz scan rate 64 ch).
** 1.9 µV and 1.7 µV for 100 Hz filter
*** 2.5 µV and 2.2 µV when temperature ≥40 °C

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above.

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30 °C	0.16 µV/°C	0 µV	0 µV	0 µV	0 µV
	30-40 °C	0.18 µV/°C	1.1 µV	0.2 µV	0.1 µV	0.1 µV
	40-55 °C	0.39 µV/°C	6 µV	1.4 µV	0.6 µV	0.6 µV

Temperature Measurement Accuracy

The thermocouple graphs following this description include the errors due to measuring the voltage output of the thermocouple, and the algorithm errors due to converting the thermocouple voltage to temperature or the Measurement/ Conversion Error (MCE). To this error the Reference Junction Measurement Error (RJME) must be added due to measuring the reference junction temperature with an RTD or thermistor (this measurement requires an E1505A). Also, the Isothermal Reference Gradient Errors (IRGE) must be added due to gradients across the isothermal reference. If an external isothermal reference panel is used, consult the manufacturer's specifications. If Agilent terminal blocks are used as the isothermal reference, see the notes below.

Total Temperature Error = $[\,(MCE)^2 + (RJME)^2 + (IRGE)^2\,]^{1/2}$

NOTES:

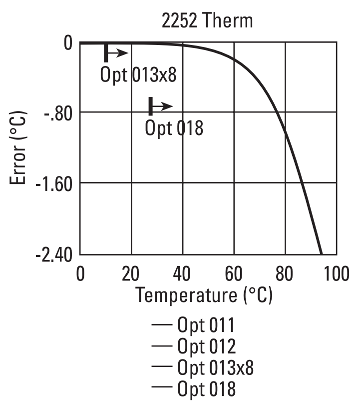
1) When using the Terminal Block as the isothermal reference, add ± 0.6 °C to the thermocouple accuracy specs to account for temperature gradients across the Terminal Block. The ambient temperature of the air surrounding the Terminal Block must be within ± 2 °C of the temperature of the inlet cooling air to the VXI mainframe.

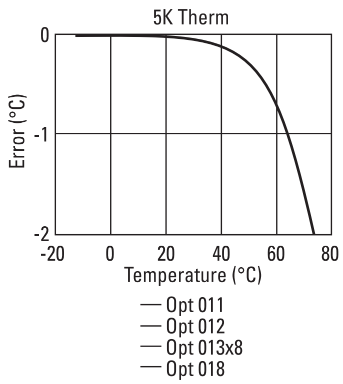
2) When using the Agilent E1586A Rack Mount Terminal Panel as the isothermal reference, add ± 0.2 °C to the thermocouple accuracy specs to account for temperature gradients across the E1586A. The E1586A should be mounted in the bottom part of the rack, below and away from other heat sources, for best performance.

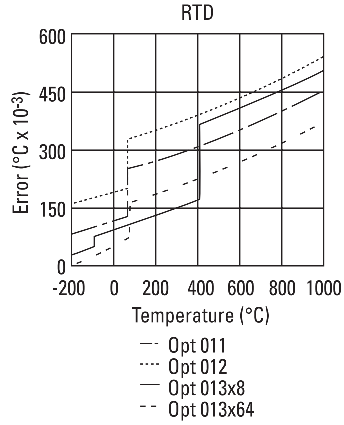
All specifications for the following were measured with the A/D filter off.

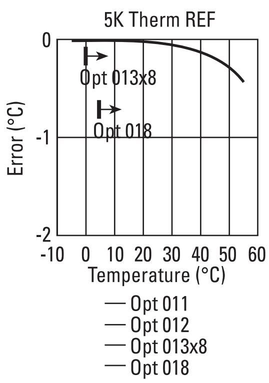
The following temperature accuracy graphs include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 transducer curves. Add your transducer accuracy to determine total measurement error.

Conversion Chart		
Opt 011	=	E1501A
Opt 012	=	E1502A
Opt 013	=	E1503A
Opt 015	=	E1505A
Opt 016	=	E1506A
Opt 017	=	E1507A
Opt 018	=	E1508A
Opt 019	=	E1509A
Opt 020	=	E1510A
Opt 021	=	E1511A




5K Therm
Error (°C)
0
-1
-2
-20 0 20 40 60 80
Temperature (°C)
— Opt 011
— Opt 012
— Opt 013x8
— Opt 018


RTD
Error (°C x 10-3)
600
450
300
150
0
-200 0 200 400 600 800 1000
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


5K Therm REF
Opt 013x8
Opt 018
Error (°C)
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-1
-2
-10 0 10 20 30 40 50 60
Temperature (°C)
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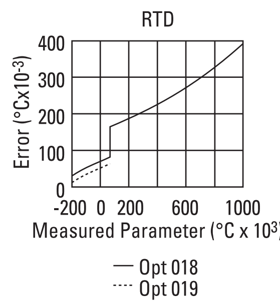
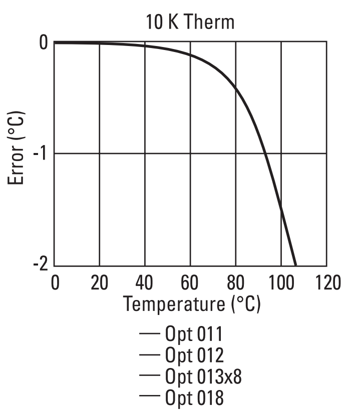
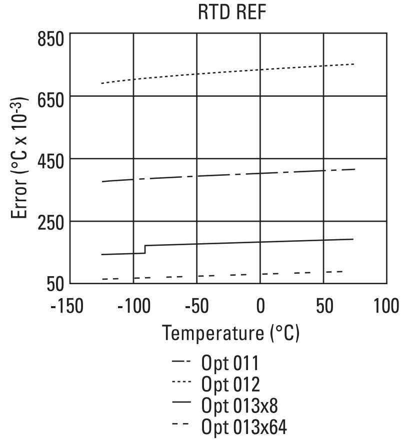
— Opt 012
— Opt 013x8
— Opt 018


RTD
Error (°Cx10-3)
400
300
200
100
0
-200 0 200 600 1000
Measured Parameter (°C x 103)
— Opt 018
Opt 019


10 K Therm
Error (°C)
0
-1
-2
0 20 40 60 80 100 120
Temperature (°C)
— Opt 011
— Opt 012
— Opt 013x8
— Opt 018


RTD REF
Error (°C x 10-3)
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650
450
250
50
-150 -100 -50 0 50 100
Temperature (°C)
Opt 011
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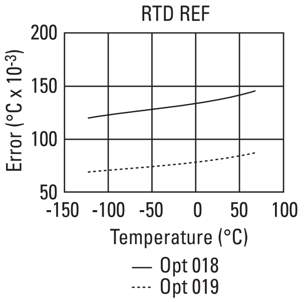
Opt 013x8
Opt 013x64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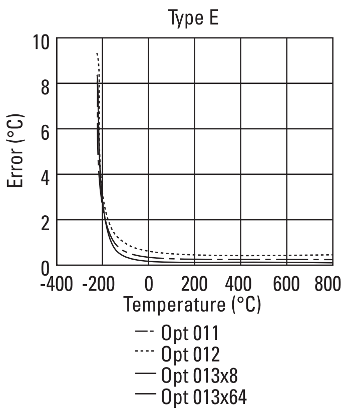
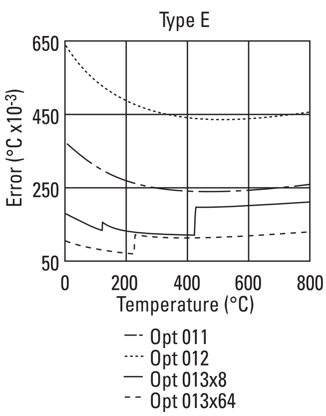
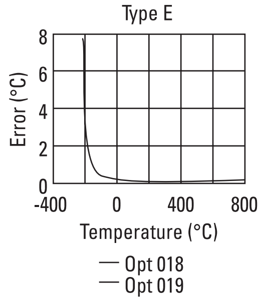
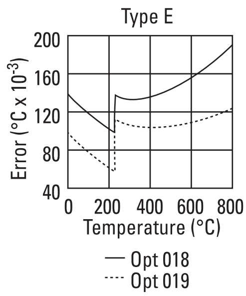
150
100
50
-150 -100 -50 0 50 100
Temperature (°C)
Opt 018
Opt 019


Type E
Error (°C)
10
8
6
4
2
0
-400 -200 0 200 400 600 800
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


Type E
Error (°C x10-3)
650
450
250
50
0 200 400 600 800
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


Type E
Error (°C)
8
6
4
2
0
-400 0 400 800
Temperature (°C)
Opt 018
Opt 019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Error (°C x 10-3)
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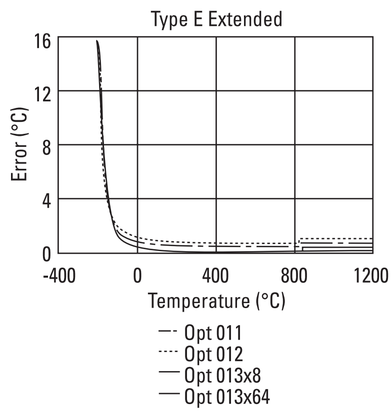
160
120
80
40
0 200 400 600 800
Temperature (°C)
Opt 018
Opt 019


Type E Extended
Error (°C)
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12
8
4
0
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Temperature (°C)
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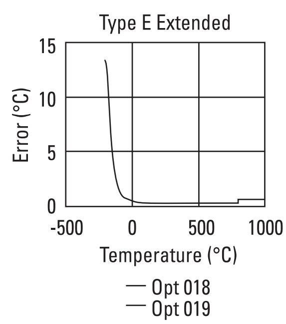
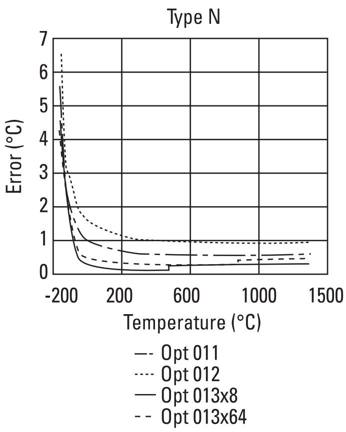
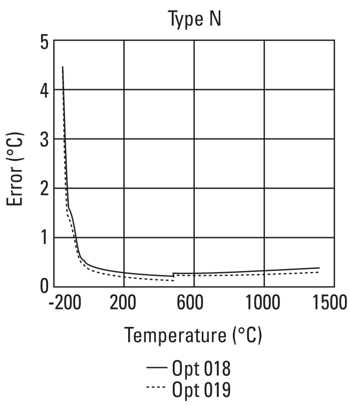
Opt 012
Opt 013x8
Opt 013x64


Type E Extended
Error (°C)
15
10
5
0
-500 0 500 1000
Temperature (°C)
Opt 018
Opt 019


Type N
Error (°C)
7
6
5
4
3
2
1
0
-200
200
600
1000
1500
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


Type N
Error (°C)
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4
3
2
1
0
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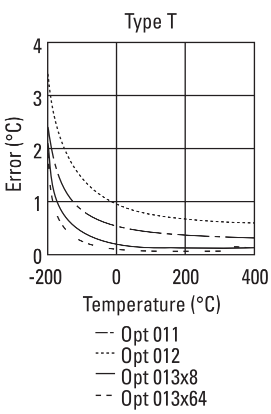
200
600
1000
1500
Temperature (°C)
Opt 018
Opt 019


Type T
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2
1
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200
400
Temperature (°C)
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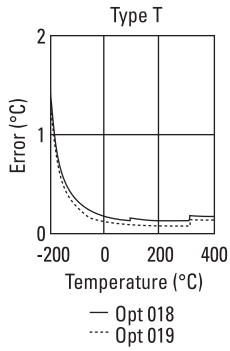
Opt 012
Opt 013x8
Opt 013x64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Error (°C)
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1
0
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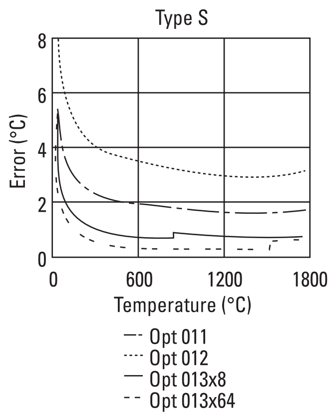
0
200
400
Temperature (°C)
Opt 018
Opt 019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6
4
2
0
0
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1200
1800
Temperature (°C)
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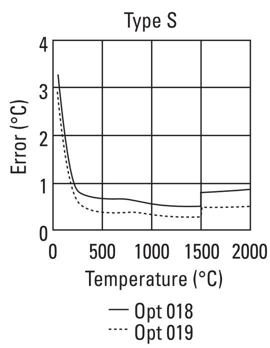
Opt 012
Opt 013x8
Opt 013x64


Type S
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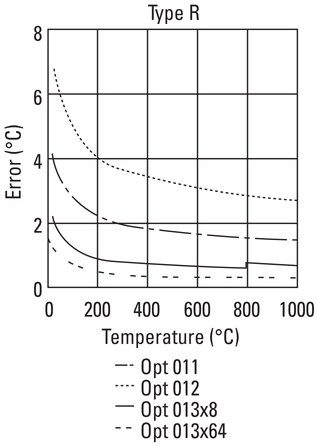
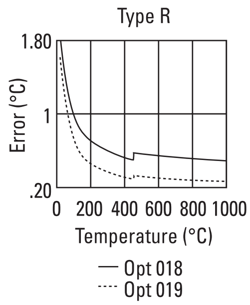
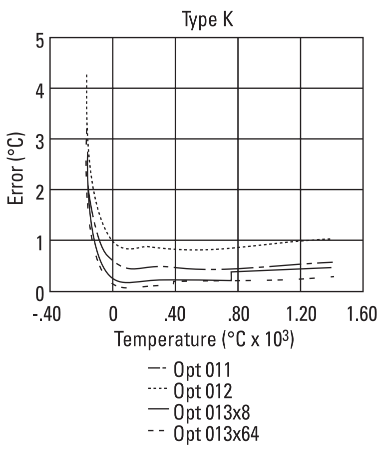
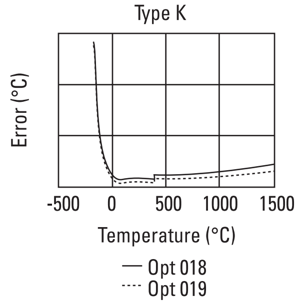
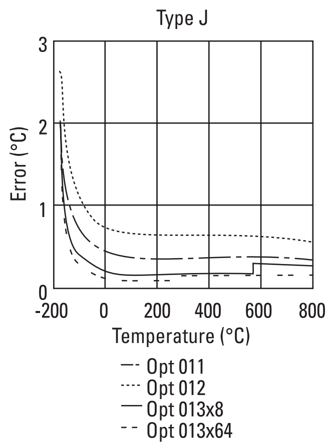
500
1000
1500
2000
Temperature (°C)
Opt 018
Opt 019

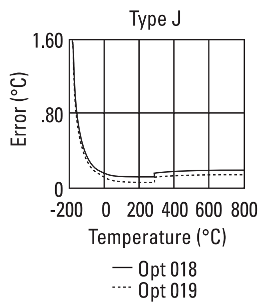












Current Requirements (Amps)

5 V typ	5 V max	24 V typ	24 V max	-24 V typ	-24 V max
0.01	0.01	0.04	0.06	0.04	0.06

Ordering Information

Description	Product No.
8-Channel Programmable Filter/Gain SCP	E1503A

Related Literature

2000 Test System and VXI Catalog CD-ROM,
Agilent Pub. No. 5980-0308E (detailed specifications for VXI products)

2000 Test System and VXI Catalog,
Agilent Pub. No. 5980-0307E (overview of VXI products)

1998 Test System and VXI Products Data Book,
Agilent Pub. No. 5966-2812E

Online

Internet access for Agilent product information, services and support
www.agilent.com/find/tmdir

VXI product information
www.agilent.com/find/vxi

Defense Electronics Applications
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Printed in the U.S.A. 04/2000
Publication No.: 5966-2389E

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